

This Page Is Inserted by IFW Operations
and is not a part of the Official Record

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images may include (but are not limited to):

- BLACK BORDERS
- TEXT CUT OFF AT TOP, BOTTOM OR SIDES
- FADED TEXT
- ILLEGIBLE TEXT
- SKEWED/SLANTED IMAGES
- COLORED PHOTOS
- BLACK OR VERY BLACK AND WHITE DARK PHOTOS
- GRAY SCALE DOCUMENTS

IMAGES ARE BEST AVAILABLE COPY.

**As rescanning documents *will not* correct images,
please do not report the images to the
Image Problem Mailbox.**

PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau



INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : C07F 17/00, B01J 31/122, C08F 10/00		A2	(11) International Publication Number: WO 96/33202 (43) International Publication Date: 24 October 1996 (24.10.96)
(21) International Application Number: PCT/US96/03656 (22) International Filing Date: 18 March 1996 (18.03.96) (30) Priority Data: 08/423,232 17 April 1995 (17.04.95) US		(81) Designated States: AL, AM, AU, AZ, BB, BG, BR, BY, CA, CN, CZ, EE, GE, HU, IS, JP, KG, KP, KR, KZ, LK, LR, LT, LV, MD, MG, MN, MX, NZ, PL, RO, RU, SG, SI, SK, TJ, TM, TR, TT, UA, UZ, VN, ARIPO patent (KE, LS, MW, SD, SZ, UG), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG). Published <i>Without international search report and to be republished upon receipt of that report.</i>	
(71) Applicant: OCCIDENTAL CHEMICAL CORPORATION [US/US]; Patent Dept., 360 Rainbow Boulevard South, Niagara Falls, NY 14303 (US). (72) Inventors: NAGY, Sandor; 2159 B Bedell Road, Grand Island, NY 14072 (US). KRISHNAMURTI, Ramesh; 121 Pepper Tree Road, Amherst, NY 14228 (US). TYRELL, John, A.; 83 East Pinelake Drive, Williamsville, NY 14221 (US). CRIBBS, Leonard, V.; 15915 Clearcrest Drive, Houston, TX 77059 (US). COCOMAN, Mary; 287 Fareway Lane, Grand Island, NY 14072 (US). (74) Agents: FUERLE, Richard, D. et al.; Occidental Chemical Corporation, 360 Rainbow Boulevard South, Niagara Falls, NY 14303 (US).			
(54) Title: TRANSITION METAL CATALYST BASED ON BIDENTATE LIGANDS CONTAINING PYRIDINE OR QUINOLINE MOIETY			
(57) Abstract			
Disclosed is a novel bidentate pyridine transition metal catalyst having general formula (1), where Y is O, S, NR, (2), or (3), each R is independently selected from hydrogen or C ₁ to C ₆ alkyl, each R' is independently selected from C ₁ to C ₆ alkyl, C ₁ to C ₆ alkoxy, C ₆ to C ₁₆ aryl, halogen, or CF ₃ , M is titanium, zirconium, or hafnium, each X is independently selected from halogen, C ₁ to C ₆ alkyl, C ₁ to C ₆ alkoxy, or (4), L is X, cyclopentadienyl, C ₁ to C ₆ alkyl substituted cyclopentadienyl, indenyl, fluorenyl, or (5), "m" is 0 to 4, and "n" is 1 to 4. Also disclosed is a method of making a poly- α -olefin comprising polymerizing an α -olefin monomer using that catalyst or a catalyst that has general formula (6), where Y, M, L, X, and R' were previously defined and each "p" is independently selected from 0 to 3.			

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

A.M	Armenia	GB	United Kingdom	M.W	Malawi
AT	Austria	GE	Georgia	MX	Mexico
AU	Australia	GN	Guinea	NE	Niger
BB	Barbados	GR	Greece	NL	Netherlands
BE	Belgium	HU	Hungary	NO	Norway
BF	Burkina Faso	IE	Ireland	NZ	New Zealand
BG	Bulgaria	IT	Italy	PL	Poland
BJ	Benin	JP	Japan	PT	Portugal
BR	Brazil	KE	Kenya	RO	Romania
BY	Belarus	KG	Kyrgyzstan	RU	Russian Federation
CA	Canada	KP	Democratic People's Republic of Korea	SD	Sudan
CF	Central African Republic	KR	Republic of Korea	SE	Sweden
CG	Congo	KZ	Kazakhstan	SG	Singapore
CH	Switzerland	LI	Liechtenstein	SI	Slovenia
CI	Côte d'Ivoire	LK	Sri Lanka	SK	Slovakia
CM	Cameroun	LR	Liberia	SN	Senegal
CN	China	LT	Lithuania	SZ	Swaziland
CS	Czechoslovakia	LU	Luxembourg	TD	Chad
CZ	Czech Republic	LV	Latvia	TG	Togo
DE	Germany	MC	Monaco	TJ	Tajikistan
DK	Denmark	MD	Republic of Moldova	TT	Trinidad and Tobago
EE	Estonia	MG	Madagascar	UA	Ukraine
ES	Spain	ML	Mali	UG	Uganda
FI	Finland	MN	Mongolia	US	United States of America
FR	France	MR	Mauritania	UZ	Uzbekistan
GA	Gabon			VN	Viet Nam

**TRANSITION METAL CATALYST BASED ON BIDENTATE LIGANDS CONTAINING PYRIDINE
OR QUINOLINE MOIETY**

Background of the Invention

This invention relates to catalysts useful in
5 polymerizing α -olefins. In particular, it relates to the
polymerization of ethylene using transition metal catalysts
with bidentate ligands containing pyridine or quinoline
moieties.

Until recently, polyolefins have been made primarily
10 using conventional Ziegler catalyst systems. A Ziegler
catalyst typically consists of a transition metal-containing
compound and one or more organometallic compounds. For
example, polyethylene has been made using Ziegler catalysts
such as titanium trichloride and diethylaluminum chloride, or
15 a mixture of titanium tetrachloride, vanadium oxytrichloride,
and triethylaluminum. These catalysts are inexpensive but
they have low activity and therefore must be used at high
concentrations. The catalyst residue in the polymers produce
a yellow or grey color and poor ultraviolet and long term
20 stability, and chloride-containing residues can cause
corrosion in polymer processing equipment. It is therefore
sometimes necessary to either remove catalyst residues from
the polymer or add neutralizing agents and stabilizers to the

polymer to overcome the deleterious effects of the residues and this adds to production costs. Furthermore, Ziegler catalysts produce polymers having a broad molecular weight distribution, which is undesirable for some applications such 5 as injection molding. They are also poor at incorporating α -olefin co-monomers, making it difficult to control polymer density. Large quantities of excess co-monomer may be required to achieve a certain density and many higher α -olefins, such as 1-octene, can be incorporated at only very 10 low levels, if at all.

Although substantial improvements in Ziegler catalyst systems have occurred since their discovery, these catalysts are now being replaced with recently discovered metallocene catalyst systems. A metallocene catalyst typically consists 15 of a transition metal compound that has one or more cyclopentadienyl ring ligands. Metallocenes have low activities when used with organometallic compounds, such as aluminum alkyls, which are used with traditional Ziegler catalysts, but very high activities when used with 20 aluminoxanes as cocatalysts. The activities are generally so high that catalyst residues need not be removed from the polymer. Furthermore, they produce polymers with high molecular weights and narrow molecular weight distributions. They also incorporate α -olefin co-monomers well.

However, at higher temperatures metallocene catalysts tend to produce lower molecular weight polymers. Thus, they are useful for gas phase and slurry polymerizations of ethylene, which are conducted at about 80°C to about 95°C, but 5 in general they do not work well as temperatures are increased. The polymerization of ethylene in solution is desirable because it allows great flexibility for producing polymers over a wide range of molecular weights and densities as well as the use of a large variety of different co- 10 monomers. Solution polymerization permits the production of polymers that are useful in many different applications. For example, both high molecular weight, high density polyethylene (PE) film useful as a barrier film for food packaging and low density ethylene co-polymers with good toughness and high 15 impact strength can be made.

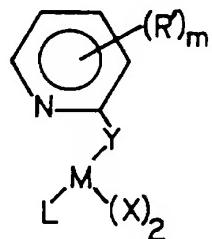
Summary of the Invention

We have discovered novel bidentate pyridine transition metal compounds which have excellent activity as α -olefin polymerization catalysts. We have also discovered that 20 bidentate quinoline transition metal compounds, which were heretofore unsuspected of possessing any catalytic properties, are also excellent polymerization catalysts for α -olefins. These catalysts produce polymers having properties very close

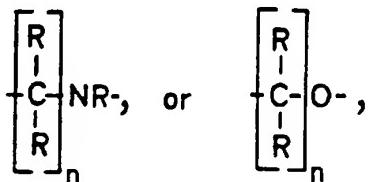
to the properties of polymers produced using metallocene catalysts. That is, the polymers have a narrow molecular weight distribution and a uniform co-monomer incorporation.

Description of the Preferred Embodiments

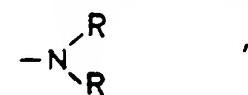
5 The transition metal catalysts of this invention containing the bidentate pyridine based ligand have the general formula



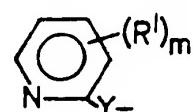
where Y is O, S, NR,



10 each R is independently selected from hydrogen or C₁ to C₆ alkyl, each R' is independently selected from C₁ to C₆ alkyl, C₁ to C₆ alkoxy, C₆ to C₁₆ aryl, halogen, or CF₃, M is titanium, zirconium, or hafnium, each X is independently selected from halogen, C₁ to C₆ alkyl, C₁ to C₆ alkoxy, or



15 L is X, cyclopentadienyl, C₁ to C₆ alkyl substituted cyclopentadienyl, indenyl, fluorenyl, or



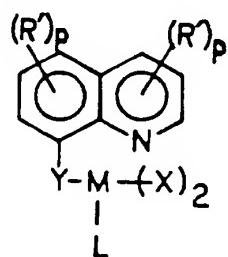
"m" is 0 to 4, and "n" is 1 to 4.

In the formula, the Y group is preferably oxygen as those compounds are easier to make. For the same reason the R group is preferably methyl and "m" is preferably 0. The L group is preferably halogen, most preferably chlorine, as those catalysts give superior properties and are easier to prepare. For the same reasons, the X group is preferably halogen, especially chlorine, and the M group is preferably titanium.

Preparation of the bidentate pyridine complexes is illustrated in the examples, but generally they can be prepared by reacting a substituted pyridine precursor having an acidic proton with a compound having the formula MX_3L in the presence of an HX scavenger. The reaction is stoichiometric and stoichiometric amounts of scavenger are preferred. Examples of suitable scavengers include compounds that are more basic than the substituted pyridine, such as triethylamine, pyridine, sodium hydride, and butyl lithium. If the scavenger is a stronger base than the substituted pyridine one can make a salt of the substituted pyridine and begin with that. While the reaction is preferably performed in a solvent, only partial solubility of the reactants is required. An aprotic solvent, such as tetrahydrofuran (THF), ether, toluene, or xylene, can be used at about 0.2 to about 20 wt% solids, and preferably at about 5 to about 10 wt% solids. The reaction can occur at about -78°C to about room

temperature. As the reaction proceeds a precipitate is formed and the product can be extracted with toluene, methylene chloride, diethyl ether, or a similar extractant.

5 The bidentate quinoline transition metal catalysts of this invention have the general formula



where R, R', L, M, X, and "n" were previously defined and each "p" is independently selected from 0 to 3.

10 The quinoline transition metal catalysts are made in a similar manner to the pyridine transition metal catalysts except that one begins with a substituted quinoline such as 8-hydroxy quinoline (also known as 8-quinolinol) instead of the substituted pyridine. Also, butyl lithium can be used in a solvent to make the lithium salt of 8-hydroxy quinoline, which can also be used as the starting material.

15 Since the catalyst is normally used in conjunction with an organometallic co-catalyst, it is preferable to dissolve

the catalyst in a solvent in which the co-catalyst is also soluble. For example, if methylaluminoxane (MAO) or polymethylaluminoxane (PMAO) is the co-catalyst then toluene, xylene, benzene, or ethylbenzene could be used as the solvent.

5 The preferred co-catalyst is MAO as it results in high activity and a polymer having a narrower molecular weight distribution. The mole ratio of the organometallic co-catalyst to catalyst when used in a polymerization is generally in the range 0.01:1 to 100,000:1, and preferably ranges from 1:1 to 10,000:1.

10 An alternative co-catalyst is an acid salt that contains a non-coordinating inert anion (see U.S. Patent No. 5,064,802). The acid salt is generally a non-nucleophilic compound that consists of bulky ligands attached to a boron or 15 aluminum atom, such as lithium tetrakis(pentafluorophenyl)borate, lithium tetrakis(pentafluorophenyl)aluminate, anilinium tetrakis(pentafluorophenyl)borate, and mixtures thereof. The anion which results when these compounds react with the catalyst is believed to be weakly coordinated to the metal-containing cation. The mole ratio of acid salt to catalyst can range from about 0.01:1 to about 1000:1, but is 20 preferably about 1:1 to 10:1. While there is no limitation on the method of preparing an active catalyst system from the catalyst and the acid salt, preferably they

5

are mixed in an inert solvent at temperatures in the range of about -78°C to about 150°C. They can also be mixed in the presence of monomer if desired. The acid salt can be used in combination with the organometallic cocatalysts described earlier.

10

15

20

25

The catalyst and co-catalyst can be used on a support such as silica gel, alumina, silica, magnesia, or titania, but supports are not preferred as they may leave contaminants in the polymer. However, a support may be required depending upon the process being utilized. For example, a support is generally needed in gas phase polymerization processes and slurry polymerization processes in order to control the particle size of the polymer being produced and in order to prevent fouling of the reactor walls. To use a support, the catalyst and co-catalyst are dissolved in the solvent and are precipitated onto the support material by, for example, evaporating the solvent. The co-catalyst can also be deposited on the support or it can be introduced into the reactor separately from the supported catalyst.

The catalyst is used in a conventional manner in the polymerization of olefinic hydrocarbon monomers. While unsaturated monomers such as styrene can be polymerized using the catalysts of this invention, it is particularly useful for polymerizing α -olefins such as propylene, 1-butene, 1-hexene, 1-octene, and especially ethylene.

The catalyst is also useful in a conventional manner for copolymerizing mixtures of unsaturated monomers such as ethylene, propylene, 1-butene, 1-hexene, 1-octene, and the like; mixtures of ethylene and di-olefins such as 1,3-butadiene, 1,4-hexadiene, 1,5-hexadiene, and the like; and mixtures of ethylene and unsaturated comonomers such as norbornene, ethylidene norbornene, vinyl norbornene, norbornadiene, and the like.

The catalysts of this invention can be utilized in a variety of different polymerization processes. They can be utilized in a liquid phase polymerization process (slurry, solution, suspension, bulk phase, or a combination of these), in a high pressure fluid phase, or in a gas phase polymerization process. The processes can be used in series or as individual single processes. The pressure in the polymerization reaction zones can range from about 15 psia to about 50,000 psia and the temperature can range from about -78°C to about 300°C.

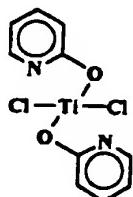
EXAMPLE 1

Synthesis of Bis(2-pyridinoxy)titanium Dichloride

To a solution of 0.02 moles of 2-hydroxy pyridine and 0.02 moles of triethylamine in 50 mL of THF, a solution of 0.01 moles of titanium tetrachloride was added dropwise at 0°C

and stirred overnight at room temperature. After filtration, the THF solution was evaporated and the product was extracted from the residue. The product has the formula:

I.

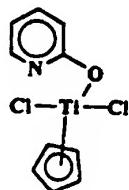


5

EXAMPLE 2Preparation of (Cyclopentadienyl)
(2-Pyridinoxy) Titanium Dichloride

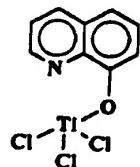
To a solution of 0.002 moles of cyclopentadienyl titanium trichloride in 50 mL of ether a solution of 2-hydroxy pyridine (0.002 moles) and triethylamine (0.002 moles) in 50 mL of ether was added at 0°C and stirred overnight. The product was recovered from the ether filtrate. The product has the formula:

II.



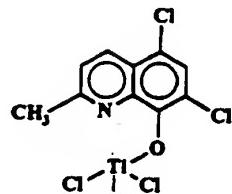
EXAMPLE 3General Procedure For Preparation
of Quinolinoxy Transition Metal Catalysts

Toluene slurries of lithium salts of various 8-quinolinol derivatives (prepared using butyl lithium) were combined with the corresponding titanium or zirconium compound (titanium tetrachloride, zirconium tetrachloride, cyclopentadienyl titanium trichloride, or cyclopentadienyl zirconium trichloride) at -78°C and stirred overnight at room temperature. The complexes were recovered from the reaction mixture by extraction with toluene or methylene chloride. To prepare 8-quinolinoxy titanium trichloride (III),



a slurry of 0.01 moles of the lithium salt of 8-hydroxyquinoline in 30 ml of toluene (prepared from 1.45 g (0.01 moles) of quinolinol and MeLi) was added at -78°C to a solution of 1.9 g (0.01 moles) of TiCl₄ in 20 ml of toluene and stirred overnight at room temperature. The precipitate was separated, washed with toluene, and extracted with 100 ml of CH₂Cl₂. After the methylene chloride had been removed, a brown microcrystalline solid (0.7 g) was isolated.

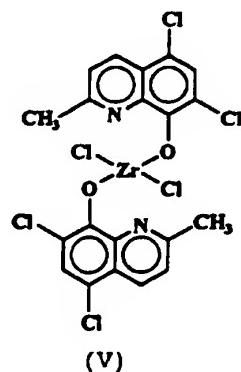
Similarly, 8-(2-methyl-5,7-dichloroquinolin)oxytitanium trichloride (IV) (2.3 g)



IV

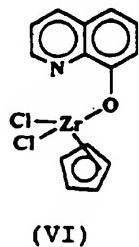
5 was prepared starting with a lithium salt made from 2.28 g (0.01 moles) of 5,7-dichloro-2-methyl-8-quinolinol.

A similar procedure was used to prepare 1.0 g of the comparative complex bis[8-(2-methyl-5,7-dichloroquinolin)oxy]zirconiumdichloride (V)

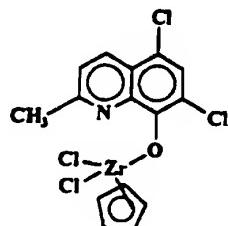


10 from 2.28 g (0.01 moles) of 5,7-dichloro-2-methyl-8-quinolinol and 1.165 g (0.005 moles) of zirconium tetrachlorid .

To prepare (cyclopentadienyl)-(8-quinolinoxy)zirconium dichloride (VI)



and (cyclopentadienyl)-[8-(2-methyl-5,7-dichloroquinolin)oxy]zirconium dichloride (VII)



lithium salts made from 1.45 g (0.01 moles) of 8-quinolinol or 1.15 g (0.005 moles) of 5,7-dichloro-2-methyl-8-quinolinol, respectively, were reacted with equimolar amounts of cyclopentadienyl zirconium trichloride in toluene at -78°C. After stirring overnight and filtering, the products (0.62 g of VI and 1.7 g of VII) were isolated from the toluene solution.

EXAMPLE 4Polymerizations

All polymerizations in this study were conducted in a 1.7 L reactor. Prior to conducting a polymerization, the 5 reactor was "baked-out" by heating to 130°C and holding at that temperature for 30 minutes under a nitrogen purge. Ethylene, hydrogen, hexene, butene, and nitrogen were treated by passage through columns containing 13X molecular sieves. For a typical polymerization, the reactor was charged with 10 0.850 L of hexane or toluene and, using a syringe, the required volume of diluted PMAO (AKZO). The desired amount of hydrogen was added to the reactor by monitoring the pressure drop (ΔP) from a 1 L stainless steel vessel pressurized with hydrogen. A toluene solution of catalyst was added to the 15 reactor by nitrogen over pressure. The reactor was maintained at isothermal conditions throughout the run. Ethylene was admitted to the reactor and controlled at 150 psi with feed on demand via a pressure regulator. After the reactor temperature and pressure stabilized, the catalyst slurry was charged into the reactor and polymerization initiated. 20 Ethylene flow was monitored via a Brooks mass flow meter.

Polymerization was terminated by venting the reactor and the polymer recovered by filtration. The polymer was stabilized by the addition of about 1000 ppm of butylated 25 hydroxytoluene/h xane (BHT) and further d volatilized 2 hours

at 80°C in a vacuum oven. Melt flow properties of the polymer were determined in accordance with ASTM D-1238. Polymer densities were measured on compression molded samples in a density gradient column in accordance with ASTM D-1505 85.

5

The following table gives the reaction conditions.

Run	Catalyst	Temp. (°C)	Co-Monomer	Catalyst (moles)	Molar Ratio Al/M	H ₂ , AP	Reaction Time (Min.)
1	I	80	None	0	9.5E-3	1897	0
2	I	80	None	0	4.7E-3	3795	0
3	I	80	None	0	4.7E-3	1897	20
4	I	80	None	0	4.7E-3	1897	20
5	I	80	Butene	20	4.7E-3	1897	20
6	II	80	None	0	9.0E-3	1001	0
7	III	80	Butene	10	8.4E-3	1074	10
8	III	80	None	10	8.4E-3	1074	10
9	IV	80	Butene	0	6.6E-3	1324	0
10	IV	80	Butene	10	6.6E-3	1324	10
11*	V	80	Butene	10	1.14E-2	1175	0
12*	V	80	Butene	10	4.06E-3	1645	0
13*	V	80	Butene	10	8.12E-3	1645	0
14	VI	80	Butene	10	6.74E-3	991	0
15	VI	80	Butene	10	1.35E-2	991	0
16	VI	80	Butene	10	1.35E-2	1288	5
17	VI	80	Butene	10	1.89E-2	1132	15
18	VI	110	Butene	10	1.89E-2	1132	0
19	VII	80	Butene	10	1.10E-2	1212	0
20	VII	80	Butene	10	1.10E-2	1212	5
21	VII	110	Butene	10	1.54E-2	1126	15
22	VII	80	Butene	10	1.54E-2	1126	0
23	VII	80	Butene	10	1.54E-2	2078	0

In the table, "Al/M" is ratio of moles of aluminum in PMAO to moles of metal (titanium or zirconium) in the catalyst.

*Comparative Example

The following table gives the result of the polymerizations.

Run	Catalyst Productivity (kg/gM/h)	M12	M120	MFR	Density	Mw/Mn
1	179.0	<0.01	<0.01	-	-	
2	153.2	<0.01	<0.01	-	-	
3	165.5	<0.01	1.8	-	-	
4	133.1	<0.01	2.47	-	-	
5	272.9	<0.01	0.964	-	-	
6	62.9	<0.01	<0.01	-	-	
7	99.2	0.90	16.9	18.9	0.9513	2.51
8	167.9	0.41	4.2	10.2	3.67	
9	103.2	<0.01	-	-	-	
10	24.8	<0.01	-	-	-	
11*	Low	-	-	-	-	
12*	none	-	-	-	-	
13*	none	-	-	-	-	
14	none	-	-	-	-	
15	98.1	<0.01	1.15	-	-	
16	177.7	0.93	21.4	23.1	-	
17	137.6	1.31	34.5	26.3	-	
18	159.0	0.81	16.1	19.8	-	
19	119.8	<0.01	.83	-	-	
20	198.7	0.46	11.4	24.7	-	
21	157.8	0.63	17.8	28.2	-	
22	160.1	0.06	12.8	-	-	
23	112.1	0.06	1.84	29.7	-	

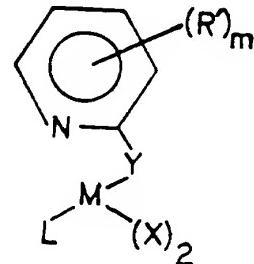
*Comparative Example

In the table, kg/gm/h is kilograms polymer produced per gram of catalyst per hour. The melt index of the polymer was measured according to ASTM D-1238, Condition E and Condition F. MI₂ is the melt index measured with a 2.16 kg weight 5 (Condition E). MI₂₀ is the melt index measured with a 21.6 kg weight (Condition F). MFR is the ratio of MI₂₀ to MI₂. The polymer density was measured according to ASTM D-1505. The molecular weight distribution of the polymer was measured using a Waters 150C gel permeation chromatograph at 135°C with 10 1,2,4-dichlorobenzene as the solvent. Both weight average molecular weight (M_w) and the ratio of M_w to M_n (number average molecular weight) are used to characterize the molecular weight distribution.

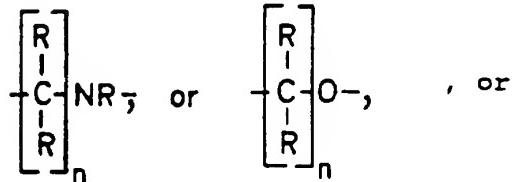
The catalysts of this invention gave good productivities 15 and high molecular weight polymers, as evidenced by very low MI values, and Catalysts VI and VII did so even at higher temperatures (110°C).

WE CLAIM:

1. A catalyst having the general formula

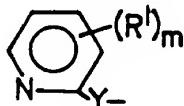


where Y is O, S, NR,



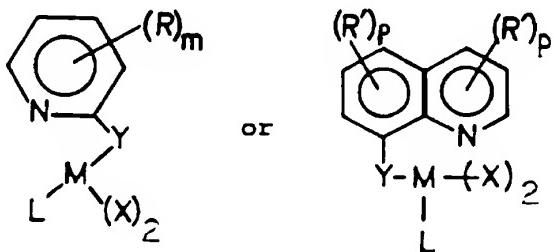
each R is independently selected from hydrogen or C, to C₆ alkyl, each R' is independently selected from C, to C₆ alkyl, C, to C₆ alkoxy, C₆ to C₁₆ aryl, halogen, or CF₃, M is titanium, zirconium, or hafnium, each X is independently selected from halogen, C, to C₆ alkyl, C, to C₆ alkoxy, or $\text{--N}(\text{R})_2$, L is X, cyclopentadienyl,

C, to C₆ alkyl substituted cyclopentadienyl, indenyl, fluorenlyl or

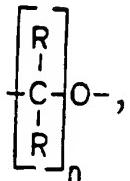
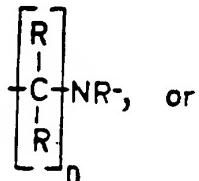


"m" is 0 to 4, and "n" is 1 to 4.

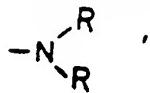
2. A catalyst according to Claim 1 wherein Y is oxygen.
3. A catalyst according to Claim 1 wherein X is halogen.
4. A catalyst according to Claim 3 wherein X is chlorine.
5. A catalyst according to Claim 1 wherein "m" is 0.
6. A catalyst according to Claim 1 wherein M is titanium.
7. A catalyst according to Claim 1 wherein M is zirconium.
8. A catalyst according to Claim 1 which is bis(2-pyridinoxy)titanium dichloride or (cyclopentadienyl(2-pyridinoxy)titanium dichloride.
9. A method of making a poly- α -olefin comprising polymerizing an α -olefin monomer using a catalyst that has the general formula



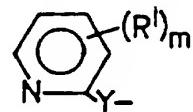
where Y is O, S, NR,



each R is independently selected from hydrogen or C, to C₆ alkyl, each R' is independently selected from R, C, to C₆ alkoxy, C₆ to C₁₆ aryl, halogen, or CF₃, M is titanium, zirconium, or hafnium, each X is independently selected from halogen, C, to C₆ alkyl, C, to C₆ alkoxy, or

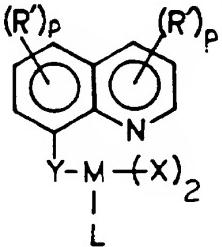


L is X, cyclopentadienyl, C, to C₆ alkyl substituted cyclopentadienyl, indenyl, fluorenyl, or



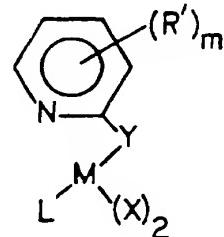
"m" is 0 to 4, and each "n" is 1 to 4, and each "p" is independently selected from 0 to 3.

10. A method according to Claim 9 wherein said catalyst has the general formula

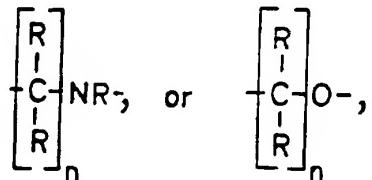


11. A method according to Claim 10 wherein Y is oxygen and X is halogen.
12. A method according to Claim 10 wherein M is titanium.
13. A method according to Claim 10 wherein M is zirconium.
14. A method according to Claim 13 wherein Y is oxygen and X is halogen.
15. A method according to Claim 14 wherein X is chlorine.
16. A method according to Claim 15 wherein L is cyclopentadienyl.
17. A method according to Claim 16 wherein R' is selected from the group consisting of chlorine, methyl, and mixtures thereof.
18. A method according to Claim 9 wherein said catalyst is selected from the group consisting of 8-quinolinoxy-titanium trichloride, 8-(2-methyl-5,7-dichloroquinolin)oxytitanium trichloride, (cyclopentadienyl)-(8-quinolinoxy)zirconium dichloride, (cyclopentadienyl)-[8-(2-methyl-5,7-dichloroquinolin)oxy]zirconiumdichloride, and mixtures thereof.

19. A method of making a poly- α -olefin comprising polymerizing an α -olefin monomer using a catalyst that has the general formula



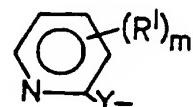
where Y is O, S, NR,



each R is independently selected from hydrogen or C, to C₆ alkyl, each R' is independently selected from C, to C₆ alkyl, C, to C₆ alkoxy, C₆ to C₁₆ aryl, halogen, or CF₃, M is titanium, zirconium, or hafnium, each X is independently selected from halogen, C, to C₆ alkyl, C, to C₆ alkoxy, or



L is X, cyclopentadienyl, C, to C₆ alkyl substituted cyclopentadienyl, indenyl, fluorenyl, or



"m" is 0 to 2, and each "n" is 1 to 4.

20. A method according to Claim 19 wherein said catalyst is selected from the group consisting of bis(2-pyridinoxy)titanium dichloride, (cyclopentadienyl)(2-pyridinoxy)titanium dichloride, and mixtures thereof.